MYCOTAXON

Volume 109, pp. 399–413 *July–September 2009*

Taxonomic studies of *Helminthosporium* from China 4. Six new species and a key to *Helminthosporium* from China

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Abstract — Six new species of the genus *Helminthosporium* are reported from China: *H. conidiophorellum, H. guangxiense, H. ligustri, H. obpyriform, H. ovoideum,* and *H. pseudomicrosorum*. *H. acaciae* is reported for the first time from China. A key to all known *Helminthosporium* species in China is provided. Type specimens are deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP).

Key words — taxonomy, hyphomycetes, saprobes

Introduction

Helminthosporium Link was established based on the type species, *H. velutinum*. It became a repository for a large number of taxa due to a lack of understanding of the generic concepts. Luttrell (1963, 1964) examined the type species and defined the genus as: "Conidia porogenous, distoseptate, maturation holosporous; conidiophores separate or grouped on more or less well developed stromata, conidial scars simple pores or flat ringed pores". Subsequently, many species were incorporated into other genera, e.g., *Alternaria*, *Bipolaris*, *Cercosporidium*, *Corynespora*, *Drechslera*, *Exserohilum* and *Exosporium* (Alcorn 1988). Ellis (1961) included 10 species in his review, and Siboe et al. (1999) summarized the conidial characteristics of 27 species accepted in the genus. Since then, several additional new species have been described (Shirouzu & Harada 2008, Zhang et al. 2004, 2007). Prior to our studies only two species of *Helminthosporium* had been reported from China: *H. microsorum* D. Sacc. and *H. solani* (Dai 1979, Teng 1996, Lu et al. 2000, Ryu et al. 2001). Our previous research revealed five new species and four new records from China (Zhang et

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al. 2003, 2004, 2007). In this paper we describe six new species and one new record for China. Specimens studied have been deposited in the Herbarium of Shandong Agricultural University: Plant Pathology (HSAUP). A key to the 18 taxa currently known from China is provided.

Taxonomy

New species

Helminthosporium conidiophorellum Meng Zhang & T.Y. Zhang, **sp. nov.** Fig. 1

MycoBank MB 513225

In substrato naturali mycelium immersum. Stromata partim superficialia, partim immersa, atrobrunnea, pseudoparenchymatica, 25–108 µm alta, 21–64 µm lata. Conidiophora fasciculata ex stromata quoque oriunda, simplicia, subcylindrica, recta vel flexuosa, septata, levia, atrobrunnea, interdum apicem versus pallidiora, 60–280 µm longa, 7–8.5 µm crassa, poris conidiiferis ad apicem et infra 1–2 septa supera praedita. Conidia per poros ad apicem conidiophori prodientia vel infra septa supera lateraliter oriunda, subulata, recta vel flexuosa, levia, infuscata, 11–17-distoseptata, interdum verruculosis ad apicem, 100–147.5 µm longa, 9.5–11 µm crassa, apicem versus ad 3–4 µm gradatim attenuata, basi cicatrice majuscula fusca vel atra praedita.

Holotype: On dead branches of an unidentified tree, Nanning, Guangxi, China, 23 X 2002, coll. T.Y. Zhang & Y.M. Wu, HSAUP02 0688 (= ZW02 0688).

Etymology: referring to the small conidiophore.

Mycelium immersed in the substrata. Stromata partly superficial, partly immersed in the substrata, dark brown, pseudoparenchymatous, 25–108 µm tall, 21–64 µm diam. Conidiophores arising in fascicles from the upper cells of the stromata, simple, subcylindrical, straight or flexuous, thick-walled, smooth, dark brown, paler towards the apex, 60–280 µm long, 7.0–8.5 µm diam, with 1–3 well-defined small pores (conidiogenous loci) at the apex and a few formed laterally just beneath the upper 1–2 septa. Conidia arising through pores at the apex of the conidiophore and laterally beneath the upper septa, straight or slightly flexuous, subulate, smooth-walled, pale brown, sometimes verruculose at apex, 11–17-distoseptate, 100–147.5 µm long, 9.5–11 µm diam in the widest part, narrowing towards the apex to 3–4 µm diam, with a large dark blackish-brown scar at the base, 2–3 µm thick.

Comments: In conidial shape and presence of stromata *Helminthosporium conidiophorellum* resembles *H. dalbergiae* M.B. Ellis (Ellis 1961). However, *H. dalbergiae* has larger (58–125 × 12–14 µm) conidia and broader (10–12 µm diam) conidiophores. Although *H. conidiophorellum* conidial morphology somewhat resembles that of *H. longisinuatum* Matsush. (Matsushima 1993) and *H. kakamegense* Siboe et al. (Siboe et al. 1999), *H. kakamegense* conidia are smaller (30–90 × 8–10 µm) and *H. longisinuatum* has S-shaped conidia and smaller (20–75 × 3.5–5.0 µm) conidiophores.

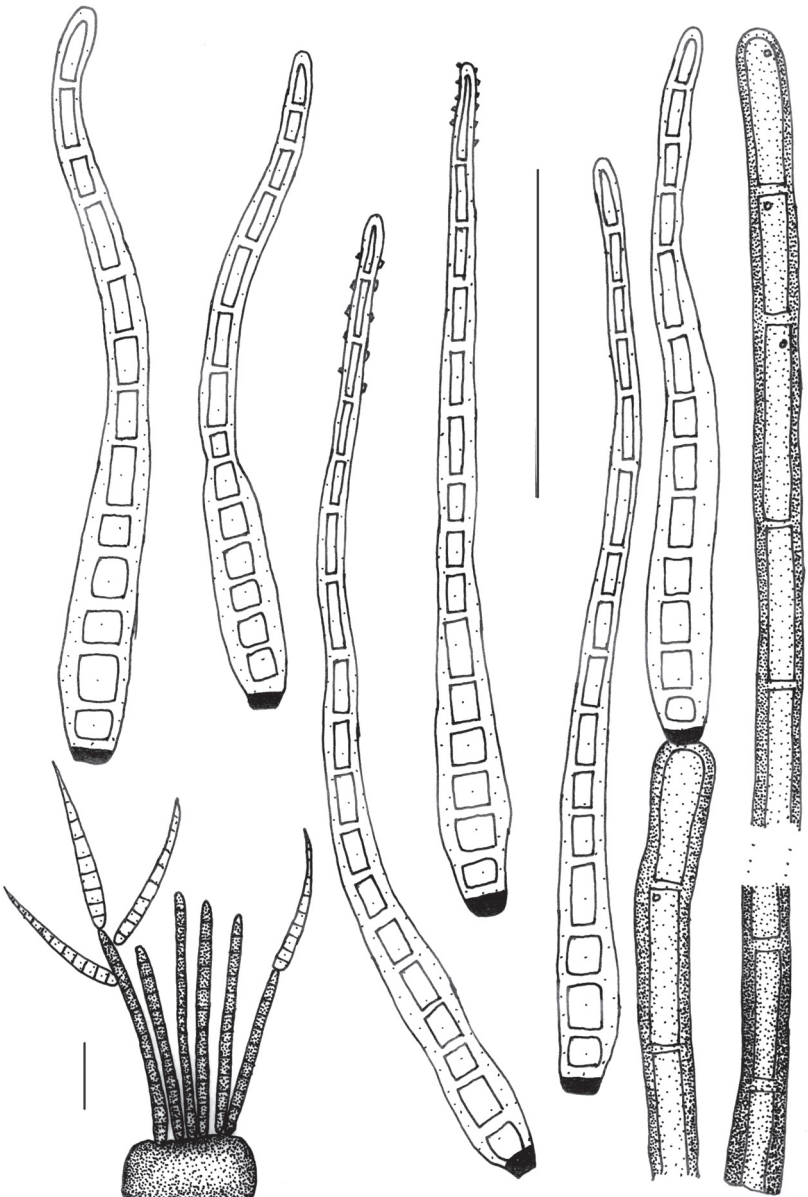

Fig.1 *Helminthosporium conidiophorellum* (bars=50 μm)
Conidia, conidiophores, and stromata on natural substratum

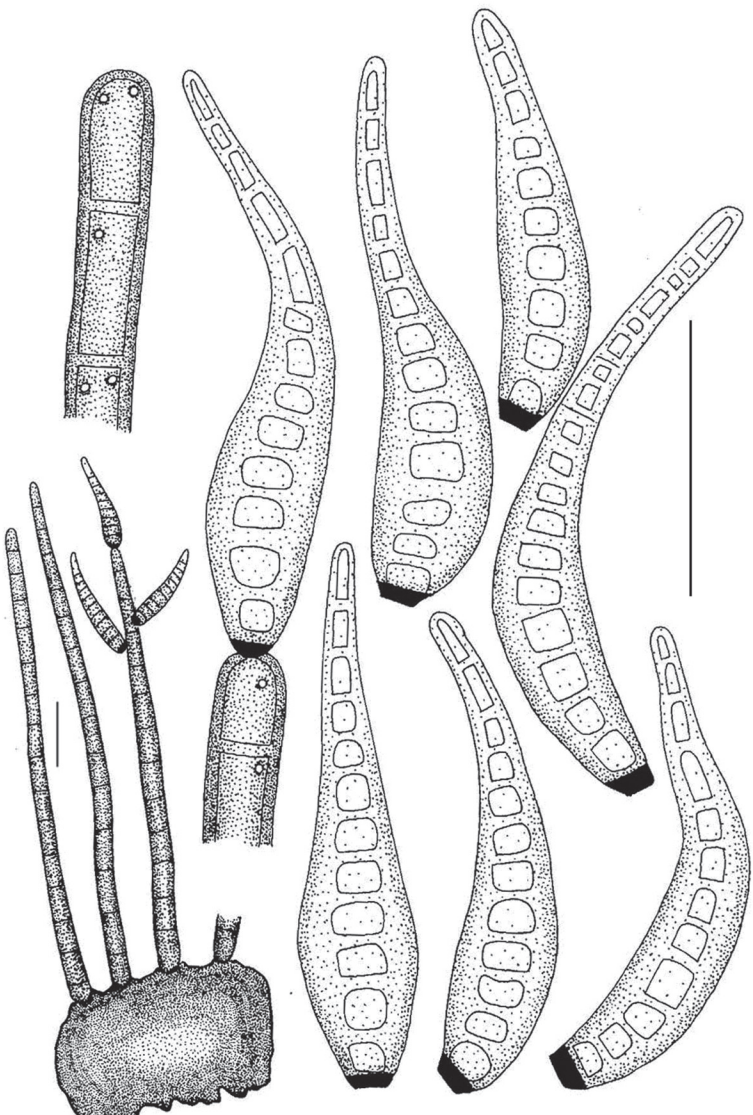

Fig. 2 *Helminthosporium guangxiense* (ex holotype, bars=50 μm)
Conidia, conidiophores, and stromata on natural substratum

Helminthosporium guangxiense Meng Zhang & T.Y. Zhang, **sp. nov.** Fig. 2

MycoBank MB 513226

In substrato naturali mycelium immersum. Stromata partim superficialia, partim immersa, atrobrunnea, pseudoparenchymatica, usque ad 60 µm alta, usque ad 129 µm lata. Conidiophora fasciculata ex stromate quoque oriunda, simplicia, recta vel flexuosa, subcylindrica, septata, levia, atrobrunnea, interdum apicem versus pallidiora, 330–850 µm longa, basi 15–20 µm crassa, apice 8–13 µm crassa, poris conidiiferis ad apicem et infra 1–4 septa supera praedita. Conidia per poros ad apicem conidiophori prodientia vel infra septa supera lateraliter oriunda, recta vel curvata, obclavata, levia, moderate brunnea, apicem versus pallidiora, 9–17-distoseptata, 76–110 µm longa, 16–22 µm crassa, apicem versus ad 3–6 µm gradatim attenuata, basi cicatrice majuscula fusca vel atra praedita.

Holotype: On dead branches of an unidentified tree, Damingshan, Shanglin, Guangxi, China, 18 XII 1997, coll. W.P. Wu, HSAUP 01352 (=WWP 1398a).

Etymology: Named for the collection locality (province).

Mycelium immersed in the substratum. Stromata partly superficial, partly immersed, dark brown, pseudoparenchymatous, up to 60 µm tall, 129µm wide. Conidiophores arising in fascicles from the upper cells of the stromata, simple, straight or flexuous, septa at 15–45 µm intervals, thick-walled, sub-cylindrical, smooth, brown, 330–850 µm long, 15–20 µm wide just above the base and 8–13 µm wide toward the apex, with 1–3 well-defined small pores at the apex and a few formed laterally beneath the upper 1–4 septa. Conidia straight or curved, obclavate, smooth, middle brown, paler towards the apex, 9–17-distoseptate, 76–110 µm long, 16–22 µm wide in the widest part, narrowing towards the apex to 3–6µm wide, with a large dark blackish-brown scar at the base, 1.5–3.5 µm thick.

Comments: *Helminthosporium guangzxiense* is most closely related in conidial morphology (obclavate shape and size) to *H. microsorum* D. Sacc. and *H. pseudomicrosorum*, which can be separated mainly by having more narrow conidiophores (100–550 × 8–14 µm in *H. microsorum*; 155–288 × 11–15 µm in *H. pseudomicrosorum*). In addition, *H. guangxiense* conidiophores are subcylindric (base thicker than apex) compared to the cylindric (base same width as apex) conidiophores characteristically found in *H microsorum* and *H. pseudomicrosorum*. The conidia of *H. guangxiense* are also thinner than those of *H. pseudomicrosorum* [17–27 µm thick].

Helminthosporium ligustri Meng Zhang & T.Y. Zhang, **sp. nov.** Fig. 3

MycoBank MB 513227

In substrato naturali mycelium immersum. Stromata absentia. Conidiophora singularia, simplicia, subcylindrica, recta vel flexuosa, septata, levia vel verruculosa, atrobrunnea, apicem versus pallidiora, crassi tunicata, 127–700 µm longa, ad basim ad 9.5–18 µm crassa, supra basim 8.5–10 µm crassa, poris conidiiferis ad apicem et infra 1–4 septa supera praedita. Conidia per poros ad apicem conidiophori prodientia vel infra septa

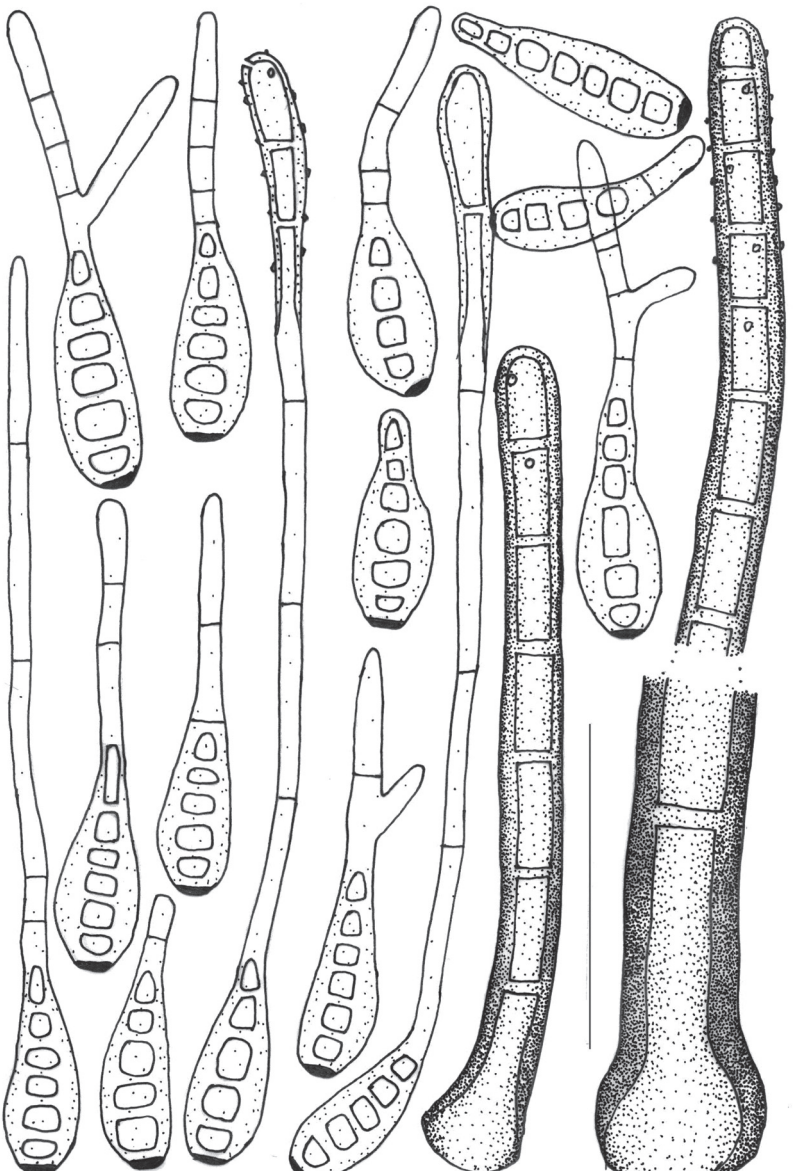

Fig. 3 *Helminthosporium ligustri* (bar= 50 μm)
Conidia and conidiophores on natural substratum

supera lateraliter oriunda, recta vel leviter flexuosa, obclavata, levia, pallide brunnea, 4–6-distoseptata, 24–38.5 × 9.5–13 µm, rostra vel pseudorostra simplicia vel ramosa, subcylindrica, septata, levia, subhyalinis vel pallide brunnea, usque ad 1000 µm longa, 3–4.5 µm crassa, apice leviter inflata, 8.5 µm crassa, levia vel verruculosa, basi cicatrice majuscula fusca vel atra praedita.

Holotype: On dead branches of *Ligustrum quihoui* Carrière, Nanning, Guangxi, China, 23 X 2002, coll. T.Y. Zhang & Y.M. Wu, $HSAUP_{02}$ 0516 (=ZW_{02} 0516).

Etymology: Named for the substrate, *Ligustrum quihoui.*

Mycelium immersed in the substrata. Stromata not formed. Conidiophores solitary, simple, straight or flexuous, septate, smooth or verruculose, thick-walled, dark brown, 127–700 µm long, 9.5–18 µm diam just above the base and 8.5–10 µm diam towards the apex, with 1–3 well-defined small pores at the apex and a few formed laterally beneath the upper 1–4 septa. Conidia arising through pores at the apex of the conidiophore and laterally beneath the upper septa, straight or slightly curved, obclavate, rostrate or pseudorostrate, smooth-walled, pale brown, subhyaline towards the apex, 4–6-distoseptate, 24–38.5 × 9.5–13 µm with a large dark blackish-brown scar at the base, 1–2 µm thick. Rostra or pseudorostra simple or sometimes branched, subcylindrical, septate, smooth, subhyaline to pale brown, up to 1000 long, 3–4.5 µm diam, apex inflated to 8.5 µm diam, smooth or verruculose.

Comments: *Helminthosporium spurirostrum* Meng Zhang et al. (Zhang et al. 2004) also has pseudorostrate conidia. However, *H. ligustri* is characterized by having verruculose and frequently branched pseudorostra.

***Helminthosporium obpyriforme* Meng Zhang & T.Y. Zhang, sp. nov.** Fig. 4

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In substrato naturali mycelium immersum. Stromata partim superficialia, partim immersa, atrobrunnea, pseudoparenchymatica, av. ad 16 µm alta, av. ad 22 µm lata. Conidiophora singularia, ex stromata quoque oriunda, simplicia, recta vel flexuosa, subcylindrica, septata, levia, atrobrunnea, interdum apicem versus pallidiora, 225–460 µm longa, basi 9.5–13 µm crassa, apice 6–8.5 µm crassa, poris conidiiferis ad apicem et infra 1–3 septa supera praedita. Conidia per poros ad apicem conidiophori prodientia vel infra septa supera lateraliter oriunda, obpyriformis, recta vel leviter curvata, levia, medio-brunnea, apicem versus pallidiora, 5–9-distoseptata, 47–74 µm longa, 14–19 µm crassa, apicem versus ad 2.5–5 µm gradatim attenuata, basi cicatrice majuscula fusca vel atra praedita.

Holotype: On dead branches of an unidentified tree, Guangxi, China, 28 XII 1997, coll. W.P. Wu, $HSAUP_{01}$0354 (=WWP 1502c).

Etymology: referring to the slightly pear-shaped conidia.

Mycelium immersed in the substrata. Stromata partly superficial, partly immersed in the substratum, dark brown, pseudoparenchymatous, av. 16 µm tall, 22 µm wide. Conidiophores arising singly from the upper cells of the stromata, simple, subcylindrical, straight or flexuous, thick and smooth-walled,

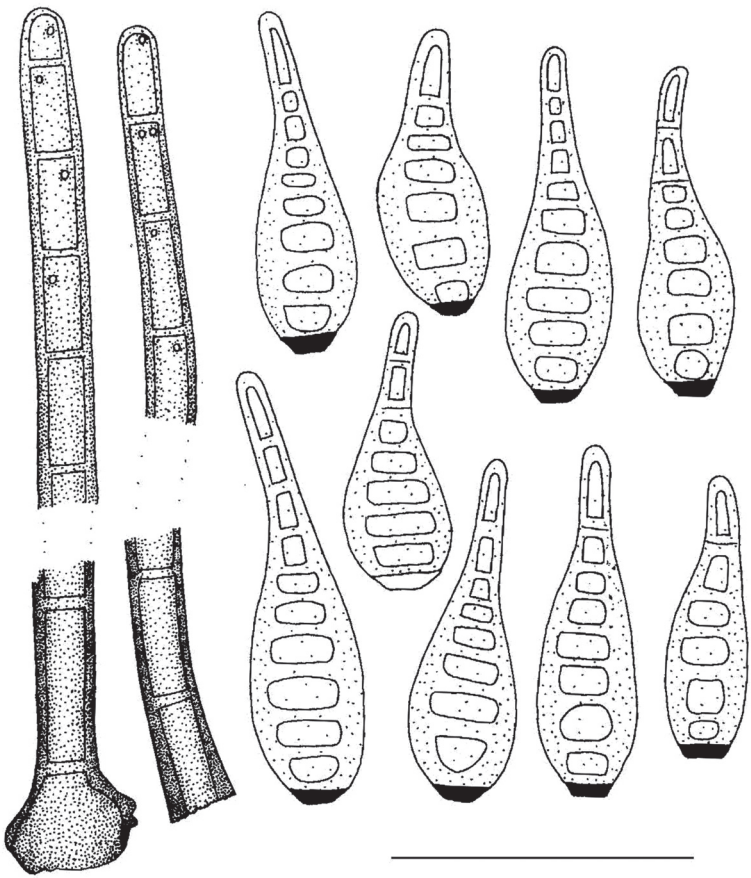

Fig. 4 *Helminthosporium obpyriforme* (ex holotype, bar=50μm)
Conidia and conidiophores on natural substratum

dark brown, paler towards the apex, 225–460 μm long, 9.5–13 μm diam just above the base and 6–8.5 μm diam towards the apex, with well-defined small pores at the apex and a few formed laterally beneath the upper 1–3 septa. Conidia arising through pores at the apex of the conidiophore and laterally beneath the upper septa, straight or slightly curved, obpyriform, smooth-walled, middle brown, paler towards the apex, 5–9-distoseptate, 47–74 μm long, 14–19 μm diam in the widest part, narrowing in diameter towards the apex to 2.5–5 μm, with a large dark blackish-brown scar at conidium base, 1–2 μm thick.

Comments: The *Helminthosporium obpyriforme* conidial size range overlaps with that of *H. velutinum* Link (Ellis 1961), but *H. obpyriforme* conidia are obpyriform and shorter and thicker than the obclavate *H. velutinum* conidia (48–118 × 11–20 µm, av. = 68 × 15 µm). Furthermore, the *H. velutinum* conidiophores are broader (250–950 µm long, 14–26 µm wide just above the base and 8.5–12 µm wide toward the apex.

Helminthosporium ovoideum Meng Zhang & T.Y. Zhang, **sp. nov.** Fig. 5

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In substrato naturali, mycelium immersum. Stromata partim superficialia, partim immersa, atro-brunnea, pseudoparenchymatica, usque ad 34.5 µm alta, usque ad 45.5 µm lata. Conidiophora singularia ex stromate quoque oriunda, simplicia, recta, subcylindrica, septata, levia, brunnea vel atro-brunnea, interdum apicem versus pallidiora, 380–510 µm longa, basi 15–25 µm crassa, apice 7.5–10 µm crassa, poris conidiiferis ad apicem et infra 1–6 septa supera praedita. Conidia per poros ad apicem conidiophori prodientia vel infra septa supera lateraliter oriunda, recta, ovoidea vel elliptica, levia, brunnea, apicem versus pallidiora, 3–8-pseudoseptata, 27–61 µm longa, 13–21 µm crassa, apicem versus ad 4.5–8.5 µm gradatim attenuata, basi cicatrice majuscula fusca vel atra praedita.

Holotype: On dead branches of an unidentified tree, Changbaishan, Jilin Province, China, 5 IX 1998, coll. W.P. Wu, HSAUP $_{01}$ 0362 (=WWP 1729).

Etymology: referring to the ovoid conidial shape.

Mycelium immersed in the substrata. Stromata partly superficial, partly immersed in the substrata, dark brown, pseudoparenchymatous, up to 35 µm tall, 45 µm wide. Conidiophores arising singly from the upper cells of the stromata, simple, subcylindrical, straight or flexuous, thick-walled, smooth, brown to dark brown, paler towards the apex, 380–510 µm long, 15–25 µm diam just above the base and 7.5–10 µm diam towards the apex, with 1–3 well-defined small pores (conidiogenous loci) at the apex and a few laterally beneath the upper 1–6 septa. Conidia arising through pores, straight, ovoid, to ellipsoidal, smooth-walled, moderately brown, paler towards the apex, 3–8-distoseptate, 27–61 µm long, 13–21 µm diam in the widest part, narrowing towards the apex to 4.5–8.5 µm, with a large dark blackish-brown scar at the base, 1.5–2.5 µm thick.

Comments: The most similar species in conidium size are *Helminthosporium acaciae*, *H. mauritianum* Cooke and *H. kalopanacis* Gornostaĭ (Siboe et al. 1999). However, conidium shape and width can be used to distinguish these species. The conidia of *H. ovoideum* are ovoid to ellipsoidal, while those of the other three are obclavate or cylindrical. The conidia of *H. ovoideum* are thicker than those of *H. acaciae* (10–15 µm diam), *H. mauritianum* (8–13 µm diam), and *H. kalopanacis* (10–17 µm diam).

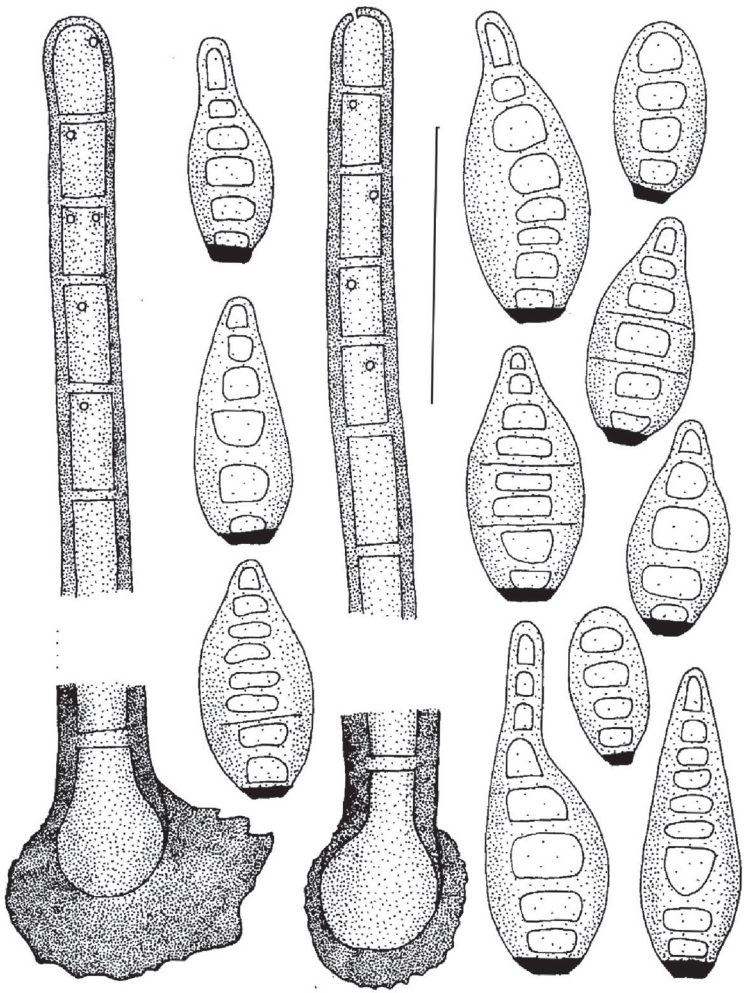

Fig. 5 *Helminthosporium ovoideum* (ex holotype, bar = 50μm)
Conidia and conidiophores on natural substratum.

Helminthosporium pseudomicrosorum Meng Zhang & T.Y. Zhang, **sp. nov.** Fig. 6

Mycobank MB 513230

In substrato naturali mycelium immersum. Stromata partim superficialia, partim immersa, atro-brunnea, pseudoparenchymatica, usque ad 86 μm alta, usque ad 45 μm lata. Conidiophora fasciculata ex stromate quoque oriunda, simplicia, recta vel flexuosa, cylindrica, septata, levia, atro-brunnea, interdum apicem versus pallidiora, 155–288 μm

longa, 11–15 µm crassa, poris conidiiferis ad apicem et infra 1–4 septa supera praedita. Conidia per poros ad apicem conidiophori prodientia vel infra septa supera lateraliter oriunda, recta vel flexuosa, obclavata, levia, brunnea, apicem versus pallidiora, 7–16-distoseptata, 82–142 µm longa, 17–27 µm crassa, apicem versus ad 3–6 µm gradatim attenuata, basi cicatrice majuscula fusca vel atra praedita.

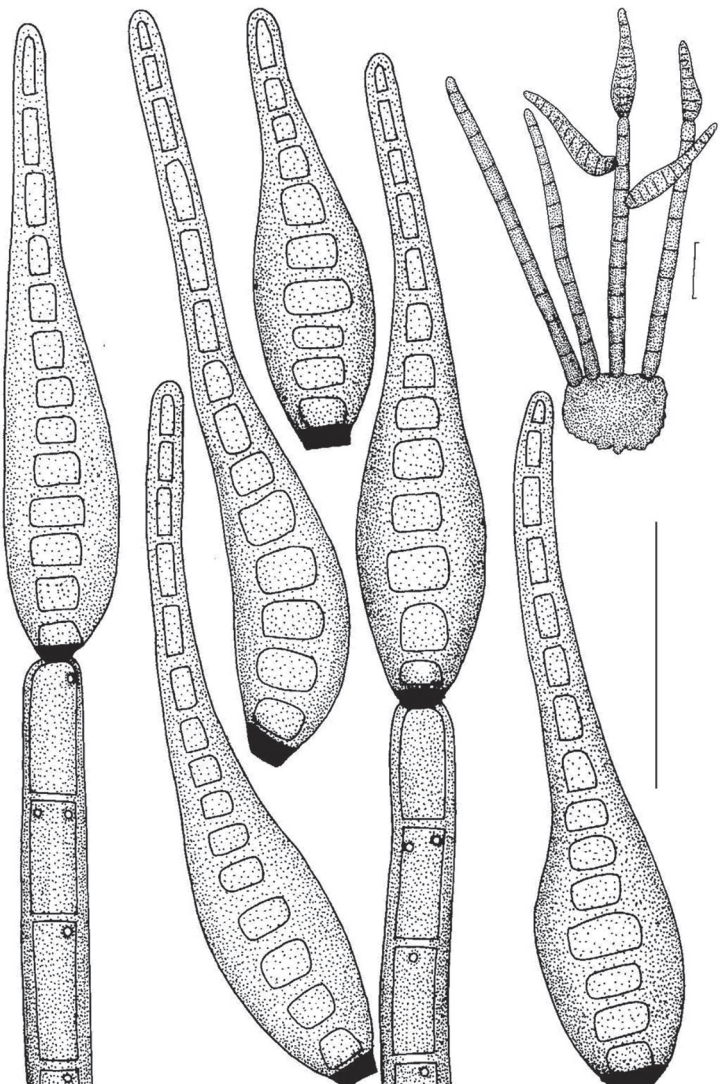

Fig. 6 *Helminthosporium pseudomicrosorum* (ex holotype, bars =50 µm).
Conidia and conidiophores on natural substratum.

Holotype: On dead branches of an unidentified tree, Changbaishan, Jilin Province, China, 5 IX 1998, coll. W.P. Wu, HSAUP $_{01}$ 0365 (= WWP 1747).

Etymology: referring to the similarity to *H. microsorum*

Mycelium immersed in the substratum. Stromata partly superficial, partly immersed in the substratum, dark brown, pseudoparenchymatous, up to 85 µm tall, 45 µm wide. Conidiophores arising in fascicles from the upper cells of the stromata, simple, cylindrical, straight or flexuous, thick-walled, smooth, dark brown, paler towards the apex, 155–288 µm long, 11–15µm diam, with 1–3 well-defined small pores (conidiogenous loci) at the apex and a few formed laterally beneath the upper 1–4 septa. Conidia tretic, arising through pores at the apex of the conidiophore and laterally beneath the upper septa, straight or slightly flexuous, obclavate, smooth-walled, brown, paler towards the apex, 7–16-distoseptate, 82–142 µm long, 17–27 µm diam in the widest part, narrowing towards the apex to 3–6 µm diam, with a large dark blackish-brown scar at the base, 2–4 µm thick.

Comments: To some extent *Helminthosporium pseudomicrosporum* resembles *H. microsorum* and *H. ahmadii* M.B. Ellis in its obclavate conidia. However, *H. microsorum* conidia are narrower (12–22 µm diam) while those of *H. ahmadii* are wider (25–30 µm diam).

New record

Helminthosporium acaciae M.B. Ellis, Mycological Papers 82: 9, 1961. Fig. 7

Mycelium immersed in the substratum. Stromata usually immersed. Conidiophores arising singly or in fascicles from the upper cells of the stromata, simple, straight or flexuous, septate in 15–35 µm intervals, smooth or verruculose, thick-walled, brown, 300–800 µm long, 7.5–13.5 µm wide just above the base and 7.5–10 µm diam towards the apex, with 1–3 well-defined small pores (conidiogenous loci) at the apex and a few laterally beneath the upper 1–5 septa. Conidia arising through the pores, straight or slightly curved, obclavate, ovoid to obpyriform, smooth-walled, pale brown, paler towards the apex, 5–9-distoseptate, 29–53µm long, 10–15 µm diam in the widest part, narrowing towards the apex to 3–5 µm, with a large dark blackish-brown scar at the base, 1.5–2.5 µm thick.

Substrate: On dead branches of unidentified tree, Kunming, Yunnan Province, 23 Oct. 1999, Coll. W.P. Wu, HSAUP $_{01}$0377 (=WWP 2533a).

Comments: The Chinese collection is similar to the original description by Ellis (1961). However, the conidiophores are verruculose and longer than the original description. The roughened surface of some conidiophores should be a new characteristic of this species

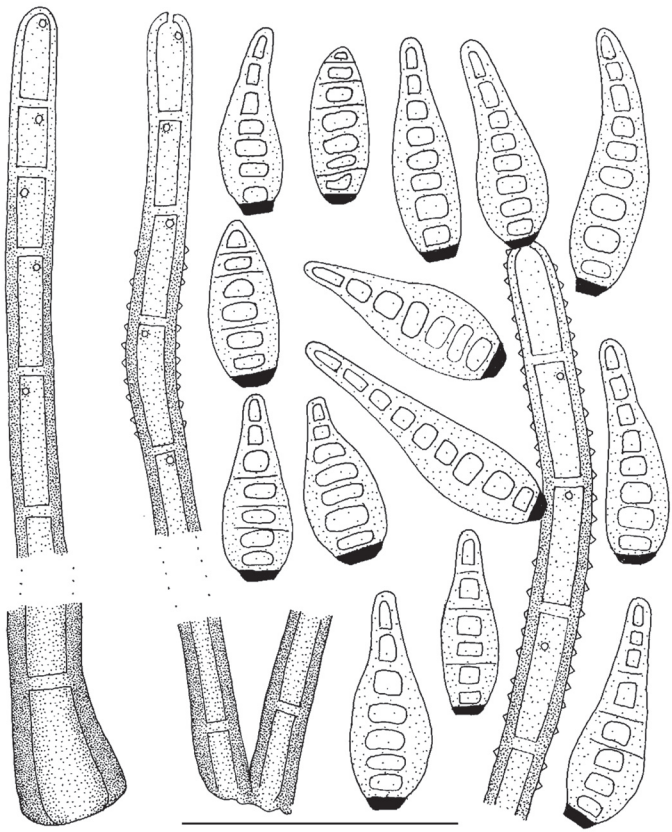

Fig. 7 *Helminthosporium acaciae* (bar =50 μm).
Conidia and conidiophores on natural substratum.

Key to the species of *Helminthosporium* from China

1. Conidia thin and long, subulate or nearly whip-like 2
   Conidia short and thick, neither subulate nor whip-like 6
2. Conidiophores arising from pseudostromata 90–280 μm tall on natural substrata 3
   Pseudostromata relatively small (< 30 μm tall) on natural substrata 4
3. Conidia average more than 15 μm diam, brown, smooth ..... ***H. microsorum***
   Conidia average less than 15 μm diam, pale brown, sometimes verruculose at apex ..... ***H. conidiophorellum***
4. Conidia often constricted at one or two central septa ..... ***H. constrictum***
   Conidia not constricted at septa, gradually thinner from the base towards apex ... 5

5. Conidia subhyaline, 6–9-distoseptate ..... ***H. subhyalinum***
Conidia pale brown, with 13–25-distoseptate ..... ***H. multiseptatum***

6. Conidia long ellipsoidal, nearly fusiform, often curved to one side 7
Conidia obclavate, obpyriform or nearly ovoid, gradually thinner from middle to top 8

7. Conidia sometimes in short chains (secondary conidia produced), 5–8 µm diam at widest part ..... ***H. senseletii***
Conidia solitary, 7–10 µm diam at widest part ..... ***H. palmigenum***

8. Conidia obpyriform ..... ***H. obpyriforme***
Conidia not obpyriform 9

9. Conidia ovoid to broadly obclavate 10
Conidia obclavate 11

10. Conidia mostly typical ovoid, 3–8-distoseptate; conidiophores smooth ..... ***H. ovoideum***
Conidia ovoid to broadly obclavate, 5–9-distoseptate; conidiophores sometimes verruculose ..... ***H. acaciae***

11. Conidia rostrate or pseudorostrate 12
Conidia not rostrate or pseudorostrate 13

12. Conidia rostrate, up to 1000 µm long, subhyaline, sometimes the conidial apex pseudorostrate and secondary conidia produced ..... ***H. ligustri***
Conidium apex often pseudorostrate, conidia of two types: (a) relatively large (52–73 × 12–15.5 µm); (b) relatively small (27–41 × 9.5–13 µm), secondary conidia produced ..... ***H. spurirostrum***

13. Conidia relatively large, average length and width more than 75 µm and 16.5µm, respectively 14
Conidia relatively small, average length and width less than 70 µm and 16 µm, respectively 16

14. The apical septa of conidia obviously constricted, with cylindrical rostra ..... ***H. bauhiniae***
Conidia gradually thinner from middle to top, not obviously constricted at septa 15

15. Average length of conidia more than 120 µm, straight or slightly flexuous ..... ***H. pseudomicrosorum***
Average length of conidia less than 100 µm, often flexuous to one side ..... ***H. guangxiense***

16. Conidia diameter averages 15 µm ..... ***H. velutinum***
Conidia diameter averages 12 µm ..... ***H. sichuanense***
Conidia diameter averages 8.5 µm ..... ***H. solani***

Acknowledgements

The authors are grateful to Dr. K.D. Hyde, Mae Fah Luang University, and Dr. Eric McKenzie, Auckland, New Zealand, for reviewing the manuscript. Thanks are also expressed to Prof. J.Y. Zhuang for correcting the Latin diagnoses, to Dr. W.P. Wu for collections, and to Mr. Y. M. Wu for inking the drawings.

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